Total No. of Printed Pages—7

1 SEM TDC CHMH (CBCS) C 2

2021

(March)

CHEMISTRY

(Core)

Paper : C–2

(Physical Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×3=3

(a) The temperature at which a gas obeys the ideal gas laws at a given range of pressure is

(i) critical temperature

(ii) reduced temperature

(iii) Boyle's temperature

(iv) All of the above

(b) The ratio of r.m.s. velocities of H_2 and O_2 is

(i) 1 : 16

(ii) 1 : 8

(iii) 1 : 32

(iv) 16 : 1

(c) With increasing temperature viscosity of liquid

(i) increases

(ii) decreases

(iii) first decreases and then increases

(iv) does not change

2. Answer any *four* questions from the following : 2×4=8

(a) Show that the excluded volume is four times the actual volume of a gas molecule.

(b) Why is heat capacity of a gas at constant pressure higher than heat capacity at constant volume?

(c) Calculate the distance between (200) planes of a cubic lattice of edge length 400 nm.

(d) What are the intermolecular forces present in liquid water? Explain.

(e) Discuss the acidic or basic nature of an aqueous solution of CH_3COONa.

UNIT—I

3. Answer any *two* questions from the following : 7×2=14

(a) *(i)* From kinetic gas equation, derive Charles' law. 2

(ii) Write the two postulates of kinetic theory of gases which are responsible for the deviation of gases from ideal gas behaviour. 2

(iii) Calculate the temperature at which root-mean-square velocity of CO_2 gas is the same as that of Cl_2 gas at 293 K. 3

(b) *(i)* Deduce the reduced equation of states from van der Waals' equation of states and define the law of corresponding states from it. 2½+½=3

(ii) State the law of equipartition of energy. Calculate the total energy in joules associated with the following molecules at 27 °C : 1+1½+1½=4

(1) H_2

(2) SO_2

(c) *(i)* Deduce the relationship for calculation of collision diameter of a gas molecule from the measurement of viscosity of the gas. 3½

(ii) What is mean-free-path of a gas molecule? Write the mathematical expression for it. Explain the effect of pressure and temperature on mean-free-path. 1½+2=3½

UNIT—II

4. Answer any *one* question from the following : 5

(a) *(i)* What is coefficient of viscosity of liquid? Give its SI unit. 1½

(ii) Describe a method of determination of viscosity of liquid in laboratory. 2½

(iii) Explain why viscosity of water is more than methyl alcohol. 1

(b) (i) What is surface energy of liquid? Show that both surface tension and surface energy have same dimensions. 1+1=2

(ii) Explain the effects of temperature and solute on surface tension of liquid. 2

(iii) Discuss the role of detergents in cleansing action. 1

UNIT—III

5. Answer any *two* questions from the following : 4½×2=9

(a) (i) State the law of rational indices. What are Miller indices of a plane that intersects the three crystallographic axes at the multiple of 1, 2 and ? 1+1=2

(ii) An element forms a b.c.c. structure of edge length 2·88 Å. If the density of element is 7·20 g/cm^3, calculate the number of atoms in 208 g of the element. 2½

(b) (i) Discuss the structure of NaCl crystal from X-ray crystallography. 2½

(ii) What is the characteristic of the lines observed from X-ray studies of simple cubic crystal system? 2

(c) (i) What is metal excess defect? 1

(ii) LiCl in Li vapours imparts pink colour. Explain why. 1

(iii) What are glasses? How are they prepared? 1+1½=2½

Or

Distinguish between nematic and smectic liquid crystals. 2½

UNIT—IV

6. Answer any *two* questions from the following : 7×2=14

(a) (i) Distinguish solubility product from ionic product. What is the relation between solubility and solubility product? 1+1=2

(ii) 25 ml of 0·01 *M* $AgNO_3$ solution is mixed with 25 ml of 0·0005 *M* aqueous solution of NaCl. Determine whether a precipitate of AgCl will be formed or not.
[Given, K_{sp} (AgCl) $1{\cdot}7\times10^{-10}$ M^2] 2

(iii) Discuss the application of solubility product principle in analysis of basic radicals in salt analysis. 3

(b) *(i)* Derive the expression of degree of hydrolysis and hydrolysis constant of a salt of strong base and weak acid. 2

(ii) What is acidic buffer? Give one example. Define buffer capacity. 1+½+1=2½

(iii) Calculate the pH of a solution made by adding 0·001 mole of NaOH to 100 cm^3 of a solution which is 0·05 *M* in CH_3COOH and 0·05 *M* in CH_3COONa. 2½

(c) *(i)* What are acid-base indicators? Give two examples. 1+1=2

(ii) Discuss the pH range of acid base indicator. 2

(iii) Explain the titration curves for different types of acid base titration. How is this helpful to choose a suitable indicator for a given titration? 2+1=3

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